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PROCUREMENT SPECIFICATION FOR DIESEL GENERATORS (50 kW and above)

Revised October 1987

Canada

PREFACE

This specification was prepared by a technical committee composed of representatives from Architectural and Engineering Services Branch and Realty Branch.

The specification is to be used on all PWC projects requiring diesel generators with ratings of 50kW and above. Sections that show alternatives or require editing are shown in square brackets [ ].

This specification supercedes all other PWC diesel generator specifications covering sizes 50kW and above.

Any comments or problems arising from the use of this specification should be referred to the Director, Electrical Engineering, Architectural and Engineering Services Branch, Public Works Canada, Ottawa, K1A 0M2.

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SPEC NOTE: Specific information is required at time of tender submission. See 16622 Appendix A.

PART 1 - GENERAL

1.1 Description of System

.1 Specification covers all requirements for the fabrication, testing, supply and delivery of a diesel electric generating set for use as an automatic, unattended emergency power source when commercial power fails. System design includes an automatic transfer switch [and a manual by-pass switch with interlock]. Deliver materials and equipment to the site completely equipped, tested and wired with all site connections correctly identified and tagged ready for installation. NOTE: SPECIFIC CLAUSES IN THIS SPECIFICATION EXCEED CSA C282-1977 REQUIREMENTS.

.2 Unit to be capable of starting, attaining settled voltage and frequency and accepting a one step application of full rated load within 15 seconds for any ambient temperature between 0°C and 40°C.

1.2 Shop Drawings and System Operation

.1 Submit shop drawings and associated schematics in accordance with Section 01340.

.2 Provide dimensioned drawings of the complete assembly showing engine, radiator and generator mounting, exhaust, gas silencer and pipe arrangement, locations of fuel and lube oil filters, fuel supply and return line connections, lube oil drain valve, coolant drain valve, air cleaner, engine instrument panel, starting motor, power and control junction boxes, engine and generator mounting feet, and weight of engine, generator, baseplate, radiator and exhaust silencer.

.3 Provide description of set operation including:

.1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking unit until unit reaches rated voltage and frequency.

.2 Manual starting and transferring to load and back to normal power.

1.2 Shop Drawings and System Operation (cont'd)

.4 Electrical schematics to be arranged for ease of comprehension. Refer to Standard Details No. 4 and 5.

.5 Complete bill of materials, including catalogue numbers.

.6 Performance data/ratings of engine and generator.

.7 Four (4) sets of shop drawings to be submitted for approval to the engineer within two weeks of contract award.

.8 Express all dimensions and data in metric units and symbols followed by in bracket imperial units and symbols wherever applicable CSA Z234.1-1979, Metric Practice Guide.

1.3 Additional Drawings

.1 In addition to drawings provided in Operation and Maintenance manual, the diesel generator set shall contain in its storage compartment, one spare set of As-built and Schematic drawings, complete set of mechanical and electrical details, and wiring diagrams.

1.4 Operation and Maintenance Manual

SPEC NOTE: Delete bilingual requirement outside Ontario and Quebec.

.1 Provide the following data for incorporation into each site maintenance manual. [Data in manual to be bilingual English and French]

.2 Bind data in vinyl, hard covered, 3-ring loose leaf binder for 215 x 280 mm size paper. Enclose title sheet, labeled "Operating Data and Maintenance Manual", project name, date and list of contents. Mark each section by labeled tabs protected with celluloid covers fastened to hard paper dividing sheets. All material to be fastened in manual to safeguard against loss.

Advertising or sales literature will not be acceptable in lieu of technical bulletins and publications.

1.4 Operation and Maintenance Manual (cont'd)

.3 Include parts catalogue, maintenance and operation bulletins for:
.1 Engine.
.2 Generator.
.3 Voltage Regulator and accessories.
.4 Exciter.
.5 Permanent Magnet Pilot Exciter, when supplied.
.6 Battery Charger and Batteries.
.7 Speed Governor.
.8 Starting Motor(s).
.9 Transfer Switch and [By-pass isolating Switch] .
.10 Controller, contactors, meters.
.11 Power circuit breakers.
.12 Enclose title sheet, project name, date and list of contents.
.13 Enclose a sheet with drawings showing a side view of generator set, and a front view of control panel with doors open and with doors closed.
.14 Operation sequence of control circuitry.
.15 Complete bill of materials including name-plate data of equipment and accessories.
.16 Certified copy of Diesel Generator Set acceptance and test data and Diesel Generator Set factory report safety devices.
.17 Sequence of operations chart.
.18 Guide to trouble shooting.

.4 Include factory warranty certificate.

.5 Crate with each unit, one copy of operation and maintenance manual, with updated drawings, plus one extra loose set of drawings.

.6 In addition to the manual crated with each unit, contractor will provide four [4] operation and maintenance manuals for each generator set to be supplied.

.7 Forward two weeks prior to the factory test, one copy of operation and maintenance manual to Engineer.

.8 Identify binders on the spine with "PWC", name of generator set manufacturer and electrical rating in kW.

1.5 Maintenance Repair Kit

.1 Provide Maintenance Repair Kit for each diesel generator set as follows:

.2 Include:
- .1 4 fuel filter replacement elements
- .2 4 lube oil filter replacement elements
- .3 4 air cleaner filter elements
- .4 2 sets of fuses for control panel
- .5 2 sets of spare bulbs
- .6 1 set of injector nozzles
- .7 1 top overhaul gasket set
- .8 2 complete sets of belts where used
- .9 1 water pump repair kit
- .10 1 complete rotating rectifier set
- .11 Special tools for unit servicing if required.

1.6 Source Quality Control

.1 Have in place or implement a quality verification program meeting the requirements of CSA CAN3-Z299.3.

.2 Reliability prediction:

.1 Estimate the reliability of the equipment during its normal life expectancy. Data submitted will provide a basis for life cycle costing and logistics support analysis by the Department.

.2 Identify critical parts through systematic, documented consideration of the following: all likely ways in which a component of equipment can fail; causes for each mode; and the effects of each failure (which may be different for each operation phase).

.3 Reliability data submitted shall also identify:

- .1 The item has a known operating life, shelf life, or environmental exposure such as vibration, thermal, etc.; or a limitation which warrants controlled surveillance under specified conditions.
- .2 The item is known to require special handling, transportation, storage, or test precautions.
- .3 The sole failure of the item causes system failure.
- .4 The item is difficult to procure or manufacture relative to state-of-the-art techniques.

1.6 Source Quality Control (cont'd)

.3 Effects of functional testing, storage, handling, packing, transportation and maintenance:

.1 Determine the effects of storage, handling, transportation, maintenance and repeated exposure to functional testing on hardware reliability.

.2 Procedures shall be established to identify:

.1 the items which deteriorate with storage age or environmental conditions (including shock and vibration, etc.);

.2 special procedure for maintenance or restoration of major components.

1.7 Factory Tests

.1 Notify Engineer [ ] days in advance of date of factory test.

.2 Examination of product: [Engineer] to make a complete mechanical and electrical examination to determine compliance with the specification and drawings with respect to materials, workmanship, dimensions and marking. Refer to Visual Inspection Checklist.

.3 Non-operational tests and checks: Perform and record following tests and checks before starting the unit:

.1 Shaft alignment, end float, angular and parallel.
.2 Cold resistance of generator windings.
.3 Belt tensioning.
.4 Equipment grounds.
.5 Electrical wiring.
.6 All grease lubricating points.
.7 Personnel safety guards.
.8 Air cleaner.
.9 Coolant.
.10 Lube oil type and level.
.11 Type of fuel.
.12 Isolator adjustment.
.13 Temperature and pressure sensors.
.14 Tools.
.15 Spares.
.16 Exhaust system.

1.7 Factory Tests (cont'd)

.4 Operation test and check: On completion of paragraph 1.7.3 start the unit. When voltage and frequency have settled, connect full load. Provide multi-channel recorder and record the following:

.1 Time for unit to start and reach settled voltage and frequency.

.2 Time from initiation of start of full load application with voltage and frequency settled.

.3 Voltage and frequency transient and steady state limits from no load to full load to no load, no load to 50% load to no load, and no load to 25% load to no load. Measure and record machine vibration levels under the same load conditions. See Test Verification Record Sheets.

.4 Measure and record all meter readings at 30 minute intervals. See Test Verification Data Sheets.

.5 Transient frequency deviation on one step application or rejection of full load $\pm$ [3]%.

.6 Frequency recovery time [3] secs.

.7 Transient voltage, deviation on one step application or rejection of full load $\pm$ [18]%.

.8 Demonstrate no torsional or other harmful vibrations within 10% above or below rated speed of unit, when operating unloaded or connected to load within its rating; include copy of torsional analysis with approval drawings. Cyclic irregularity to be no greater than 1/250.

.9 Protection and control demonstration: On completion of paragraph 1.7.4 demonstrate the following:

- .1 Coolant overheat protection.
- .2 Low oil pressure protection.
- .3 Cranking cut out.
- .4 Overcrank protection.
- .5 Overspeed protection.
- .6 Low engine temperature.
- .7 Low battery power level.
- .8 All control functions.

.10 Demonstrate the protection and operation of the low lube oil pressure switch and coolant over- temperature switch in the following manner:

1.7 Factory Tests (cont'd)

.4 (cont'd)

.1 The operation of low lubricating oil pressure switch to be demonstrated by connecting to the oil pressure line a pressure test line consisting of a short length of steel pipe containing a globe valve, a pressure gauge and the low pressure switch. The oil to be slowly throttled until the pressure switch operates its contacts. Pressure at which switch operates to be recorded in factory test report.

.2 The operation of the over-temperature switch to be demonstrated by removing the switch and immersing it in a heated container of water until the temp. switch operates its contacts. Switch operation to be monitored by a thermometer immersed in the water. Record on Test Verification Data Sheets.

.11 Factory test report to be completed during test. Refer to Test Verification Record and Data Sheets. Load test to be of [9] [25] hours' duration, comprising [8] [24] hours at 100% load and 1 hour at 110% of full load in ambient room temperature of not less than 40°C.

.12 Interpretation of ambient room temperature: Consider ambient room temperature as that temperature, which is the lowest temperature registered out of a group of three thermometers when placed in engine room as follows:

.1 One thermometer located on each side of the engine block, approximately two-thirds of the length of the block back from front (radiator) end of block, three feet out from block and at a height equal to height of block. A third thermometer located over end of generator on the unit centre line approximately 150 mm above top of generator.

.13 Demonstrate:

.1 Operation of function selector switch modes to meet requirements described in this Section, starting, stopping, and transferring of loads.

.2 Operation of automatic alarms and shutdown devices.

.3 [Operation of manual by-pass switch.]

.14 Submit original of test report to Engineer prior to shipping engine generator set.

.15 Additional tests - Perform any tests specified in the contract, which the engineer may require to indicate satisfactory operation of the unit.

1.8 Delivery

.1 Notify Engineer four weeks in advance of delivery and supply four (4) copies of complete and itemized shipping lists. Each item to be clearly marked, identified and referenced to the shipping lists.

1.9 Guarantee

.1 Each item of equipment, instrument and device furnished for and in connection with this Contract to be guaranteed against:
.1 faulty or inadequate design or operation.
.2 improper assembly.
.3 defective material or workmanship; and
.4 failure which might occur under normal and proper operation of the equipment under specified conditions.

.2 Provide a written guarantee, signed and issued in the name of Her Majesty the Queen in right of Canada, stating that the Diesel Generator Set is guaranteed against defects for a period of 2 years or 1500 hours, which ever occurs first, from the date of the Final Certificate of Completion. This final certificate to be issued by Engineer.

1.10 Packing and Crating

SPEC NOTE: Use 1.10 for storage in excess of six months.

.1 Packaging will be such as to withstand all handling during shipment either by road, rail or air.

.2 All packaging will be waterproof, dustproof, and will contain an adequate quantity of "Silicagel" for protection against humidity.

.3 Boxes will have the complete forwarding address (as specified) on at least three locations; these shall be 25 mm stencils.

.4 Clearly identify and number each package of equipment and material to ensure that each complete diesel generator set can be properly identified, and can be stored in separate packages at different locations.

1.10 Packing and Crating (cont'd)

.5 Description of materials and weight to be clearly stenciled on at least two sides.

.6 Boxes will bear such indications as follows, if required: "FRAGILE", "USE NO HOOKS", "THIS SIDE-UP", etc.

.7 Boxes that are overly long or that are unevenly packaged will bear markings, to indicate the location of the center of gravity.

.8 Boxes that are to be manipulated by cranes will be equipped with hooks and the position of the slings will be indicated on the boxes.

.9 Packaging will consist of:
20 mm plywood (standard sheeting grade spruce or fir), lined with waterproof tar paper, mounted on appropriate skids, with 50 mm by 100 mm cleating and bracing (or greater when required by weight), with 30 mm steel strapping.

PART 2 - PRODUCTS

2.1 Engine

.1 Requirements:
.1 Provide full diesel, [naturally aspirated] [turbo charger] liquid cooled engine.
.2 Auxiliary starting aids (e.g. glow plug assist start) not acceptable.
.3 Provide graduated markings around engine flywheel or equivalent means to facilitate fuel injection and valve timing.
.4 Provide removable wet type cylinder liners and cylinder head with removable valve seat insert and guides.
.5 Turbochargers to be provided with a lubricating oil reservoir as shown in Standard Detail No. 3.

.2 Rating:
.1 Rated continuous power in kW at 1800 RPM after adjustment for power losses in auxiliary equipment necessary for engine operation; to be calculated as follows:

* Rated continuous power output =

$$\frac{\text{Generator Continuous Duty Rating kW}}{\text{Generator Eff @ FL}}$$

* Continuous power as defined in ISO 3046/1-1986.

2.1 Engine (cont'd)

.3 Site conditions:
.1 Altitude [ ] m.
.2 Ambient temperature [ ] °C.
.3 Relative humidity [ ] %.

SPEC NOTE: Select remote mounted or unit mounted radiator.

.4 Cooling System:
.1 Remote mounted radiator:
.1 [Horizontal core, vertical air flow] [vertical core, horizontal air flow] sized for 15% fouling factor. Cooling fan speed adjustable belt driven, sound level 85 dba @ 7 m maximum.
.2 To maintain manufacturer's recommended engine temperature range at 110% overload for 1 hour within a 12-hour period of continuous operation at full load in ambient temperature of 40°C.
.3 Cooling system thermostatically controlled with ethylene glycol anti-freeze non-sludging above [ ]°C.
.4 Radiator casing shall be fabricated of heavy gauge galvanized steel with zinc plated nuts and bolts, mounted on heavy die-formed legs of matching materials. Its coils shall have high-efficiency heat transfer surfaces, such as seamless copper tubing with hydraulically-bonded aluminum fins. All coils and piping shall be leak tested to 300 psi under water. External pipe connections shall be flange type.
.5 Fan drive motors [weather protected type 1] [TEFC] wired to common raintight junction box.
.6 Provide hot well tank as required. Tank to be provided with a sight glass, breather/vent, fill port and cap.

2.1 Engine (cont'd)

.2 Unit mounted radiator:

.1 Liquid cooled, heavy duty industrial type supplied with duct flange, mounted on generator set base. Radiator cooling fan to be pusher type, direct drive or minimum two belt drive with belt adjuster [charging alternator shall not be used as a belt adjuster]. Fan pulley and belt to have an easily removable protective cage.

! To maintain manufacturer's recommended engine temperature range at 110% continuous overload for 1 hour within a 12-hour period of continuous operation in ambient temp. of 40°C.

.3 Cooling system shall be thermostatically controlled, with ethylene glycol anti-freeze non-sludging above [ ]°C.

.4 All non-metallic cooling system hoses except those requiring sharp formed bends shall be of the reinforced silicon rubber type with proper end fittings and means of securing.

.5 Readily accessible drain valves for draining coolant from engine block and radiator.

.4 Block Heater:

.1 Thermostatically controlled coolant heater sized to maintain engine coolant at [40]°C in an ambient temperature of [10]°C. Heater fed from normal power. Heater circuit over current protection mounted in control panel.

.2 Obtain circulation of heated coolant on thermosyphon principle. However, if this does not provide sufficient circulation to avoid hot/cold spots in the system, provide thermally protected electric motor driven circulating pump to operate automatically when heater is energized. Motor to be 120 V single phase TEFC type.

.3 Heater and thermostat to be Kim Hotstart Mfg. Co. or equivalent.

2.1 Engine (cont'd)

.5 Fuel System:
.1 Type A fuel oil: to CGSB CAN2-3.6-M83 Diesel Fuel.
.2 Fuel lift pump and two stage filters.
.3 All non-metallic fuel hoses shall be of the reinforced rubber type with crimped or swagged end fittings.

.6 Speed Governing:
.1 Provide electronic type governor with speed changer and dry type electric actuator. Governor speed droop shall be externally adjustable from zero % (isochronous) to 5% with engine running.
.2 Steady state governing speed band $\pm$0.25%.
.3 Governor to maintain transient frequency deviation on one step application or rejection of full load within $\pm$[3]%.
.4 Frequency recovery time [3] secs.
.5 Temperature in area of governor installation not to exceed 70°C.
.6 Fuel rack solenoid to be fail safe. Operate in the energized to run mode.

.7 Lubrication system:
.1 Provide a full pressure lubricating system complete with duplex filters, oil cooler and turbocharger oil reservoir. See standard detail No. 3.
.2 Pressure lubricated by engine driven pump.
.3 Engine sump drain pipe, gate valve and pipe cap.
.4 The engine to operate satisfactorily when using engine lube oil, 15W40 specified in MIL SPEC, MIL-L-2104D.
.5 All non-metallic oil hoses shall be of the reinforced rubber type with crimped or swagged end fittings.

SPEC NOTE: If any control devices are affected by low battery voltage during crank cycles install separate control battery and charger in control panel.

.8 Starting system:
.1 Provide position shift gear engaging starter. Starter motor voltage shall be as recommended by the engine manufacturer.
.2 Provide cranking limiter for one or more cranking cycles.

2.1 Engine (cont'd)

.8 Starting system: (cont'd)

.3 Starting Batteries: Lead calcium [24] [12] volts in molded rubber containers with screw type vent caps and lead plated copper inter cell connectors. Battery capacity sufficient to provide a total of 75 seconds cranking at 0°C, consisting of five 15-second cranking attempts with 15-second rest between each attempt and with a battery end voltage of not less than 75 per cent. Voltage measured at terminals at end of 75 seconds cranking, with cranking current flowing, to be not less than 1.5 V per cell. Size battery on the basis of engine and battery manufacturer's published data. Batteries to be dry charged, specific gravity of electrolyte 1.250 when fully charged at 25°C.

.4 Supply battery derating curve of A.H. capacity vs. temperature down to minus 20°C.

.5 Provide battery rack fabricated from angle iron in a two step configuration complete with flame retardant rail insulators. Paint with anti-corrosive paint. Provide battery protective cover.

.6 Provide necessary flexible battery cables and compression connectors. Battery cables to meet the requirements of CSA 22.2 No. 95 Welding Cable. Select wire size to limit voltage drop to 5% during crank cycle.

.9 Exhaust System:

.1 Provide heavy duty spiral residential type silencer with condensate drain and 500 mm of stainless steel exhaust flex flanged at engine end c/w fittings and accessories.

.10 Engine Panel:

.1 Free standing shock mounted engine instrument panel as shown in Standard Detail No. 2 to consist of:

.1 Lube oil pressure gauge
.2 Lube oil temperature gauge
.3 Coolant temperature gauge
.4 Running time meter indicating up to 999.9 hrs.
.5 [Tachometer]
.6 [Exhaust pyrometer] (to read each bank for Vee configuration).

2.1 Engine (cont'd)

.10 Engine Panel: (cont'd)

.2 Gauges: Accuracy ± 5% in operating range, black faced with white markings and pointer. Minimum size [45 mm] with 90° sweep.

.3 Provide wiring harness with lockable connectors to permit mounting of panel up to 1000 mm from generator set.

.11 Adequate guards to be provided to protect operating personnel from fans and other exposed moving parts and exhaust manifolds. Guards to be so located that normal maintenance inspections can be undertaken without their removal.

.12 Drip tray: full width of inside frame and extending from radiator to rear of flywheel housing.

2.2 Generator

.1 Generator to CSA C22.2 No. 100-M1985 and NEMA MG 1-1978.

.2 Rating: [ ] V, [3Ø], [ ] wire, [ ] kW, 60HZ.

.3 Revolving field, brushless single bearing type. Dynamically balanced rotor permanently aligned to engine by SAE-sized flexible disc coupling.

.4 Drip proof.

.5 Amortisseur windings.

.6 Exciter: Rotating brushless with surge protection for rotating rectifier assembly.

.7 Generator winding temperature rise not to exceed 105°C as measured by resistance at an ambient temperature of 40°C. NEMA Class F insulation system.

.8 Identify generator windings with metal tags. Bring windings to insulated terminals in a metal junction box mounted on the generator. Size junction box to permit mounting of engine and generator low voltage controls and wiring terminal blocks. Provide barrier in junction box to separate low and high voltage wiring.

.9 Voltage regulator: Solid state type with [three] phase sensing to control generator output within ± 1% no load to full load. Regulator and voltage adjust rheostat to be located in control panel.

2.2 Generator (cont'd)

.10 Transient voltage deviation on one-step application or rejection of full load at rated PF ±[18]%.

.11 Provide static boost or permanent magnet generator to sustain input voltage to regulator under short circuit conditions. Generator to be capable of sustaining 300% rated current for a period not less than 10 seconds permitting selective tripping of down stream protective devices.

.12 Generator circuit breaker:
- .1 [Molded case with thermal/magnetic trip.]
- .2 [Molded case with solid state trip units.]
- .3 [Drawout air circuit breaker]

.13 Balanced telephone influence factor (TIF) to NEMA Standard MG 1-1978.

2.3 Structural Steel Mounting Base

.1 Complete generating set to be mounted on structural steel baseplate of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface. Leveling shims to be used only under generator feet.

.2 Assembly to be fitted with vibration isolators mounted under baseplate. Isolators to be equipped with neoprene snubbers. Isolation efficiency will be not less than 95%.

.3 Provide elastomer mounts of non skid neoprene rubber for assembly between concrete slab and isolators.

2.4 Control Panel

.1 To CSA C22.2 No. 14-M1985 Industrial Control Equipment.

.2 Totally enclosed [Free Standing] [wall mounted] to include but not limited to the following:
- .1 Automatic engine starting and shutdown controls.
- .2 Generator controls.
- .3 Voltage regulator.
- .4 Alarm annunciators.
- .5 Battery charger circuit breaker.
- .6 Block heater circuit breaker.
- .7 Damper motor circuit breaker.
- .8 [Transfer switch]
- .9 [Bypass isolation switch]

2.4 Control Panel (cont'd)

.3 Provide wire duct for control interconnections within the panel.

.4 All control wire terminations are to be identified by numbered tubular sleeve markers.

.5 Supply two loose sets of wiring markers for each external wiring connection. Markers to be stored in a plastic bag and secured inside the panel.

.6 Alarm and shutdown devices shall be manually reset.

.7 The alarm and shutdown circuit shall include one common set of normally closed contacts for remote indication of an alarm condition. These contacts shall open in the event of any fault, and shall remain open until manually reset.

.8 Control wiring shall be stranded minimum No. 18 A.W.G., TEW, colour coded as follows:
- .1 Blue - D.C. control
- .2 Red - A.C. control
- .3 Black - P.T. secondary connections
- .4 Orange - C.T. secondary connections
- .5 Yellow - interlocks
- .6 Brown - generator excitation
- .7 White - neutral
- .8 Green - equipment ground.

.9 Label control panel terminal blocks for all external connections.

.10 Lamicoid identification plates shall be used for all instruments and controls with the exception of the control module. Nameplates shall be secured to panel with rivets or screws.

.11 Provide a storage compartment in the logic control cubicle for safekeeping of O&M manuals, as built and schematic drawings.

.12 Sign to be installed on the equipment indicating that it may start at any time as shown in Standard Detail No. 1.

2.4 Control Panel (cont'd)

.13 Annunciator lights for:
- .1 Overcurrent trip - Red
- .2 Manual Mode - Red
- .3 Automatic Mode - Green
- .4 Breaker Open - Red
- .5 Breaker Closed - Green

.14 Battery Status Indicators:
- .1 Low Battery Voltage - Amber
- .2 High Battery Voltage - Red

.15 Provide door latching mechanism to maintain door in open position.

.16 The logic section of the control panel shall contain the engine controls and annunciation, electrical monitoring equipment, electrical metering, [transfer controls].

.17 Engine controls and annunciation shall consist of the following:
- .1 Low oil pressure shut down and alarm indicator.
- .2 High engine temperature shut down and alarm indicator.
- .3 Low engine temperature alarm indicator.
- .4 Overspeed shut down and alarm indicator.
- .5 Overcrank shut down and alarm indicator.
- .6 Cycle cranking adjustable [set for 3 cycles] to include time delay feature.
- .7 Low fuel alarm indicator.
- .8 Lamp test.
- .9 Time delay to inhibit shut downs on start-up.
- .10 Electronic speed switch for crank disconnect and overspeed sensing. Signal to be obtained from alternator output (ahead of generator circuit breaker) or magnetic pick-up.
- .11 Provision for remote annunciation of alarms.
- .12 Emergency shutdown and alarm indicator with provision for remote shutdown and alarm indication.

2.4 Control Panel (cont'd)

.13 Function selector switch to provide the following modes:

.1 Off: engine-generator is off and time delay on retransfer to normal is bypassed.

.2 Auto: to provide automatic operation of the engine-generator and transfer system.

.3 Test FL: to test engine-generator and transfer switch under load by simulating a normal power failure. In the event of engine-generator failure, the transfer switch shall restore normal power to the load.

.4 Manual (Test NL): to exercise the engine-generator without load transfer. If the normal supply fails during this mode, the load must automatically transfer to the engine-generator.

.18 Electrical Monitoring:

.1 Voltmeter, ±2% accuracy, minimum [90 mm analog] [12 mm digital].

.2 Ammeter, ±2% accuracy, minimum [90 mm analog] [12 mm digital].

.3 Frequency meter, ±1% accuracy, minimum [90 mm analog] [12 mm digital].

.4 Source selector switch - 2 position, to connect voltmeter and frequency meter to normal or emergency source.

.5 Voltmeter phase selector switch - 7 positions.

.6 Ammeter phase selector switch - 4 positions.

.7 Potential transformers as necessary.

.8 Current transformers as necessary.

.9 Fuses as necessary.

2.5 Automatic Transfer Switch

.1 Transfer switch: to CSA C22.2 No. 178-1978.

.2 CSA Type "A" designation contactor type transfer switch, three phase, electrically operated and mechanically held. [Open type] [With EEMAC type] [ ] enclosure.

.3 Ratings: [ ] V, [ ] A.

.1 withstand [ ] kA symmetrical.
[ ] kA asymmetrical.

2.5 Automatic Transfer Switch (cont'd)

.4 Transfer switch to be equipped with the following accessories:
.1 Auxiliary contact to initiate emergency generator start-up on failure of normal power.
.2 Adjustable time delay to override momentary normal source outages set at [3] seconds.
.3 Adjustable time delay on transfer to emergency, set at [2] seconds.
.4 Adjustable time delay on retransfer to normal, set at [5] minutes.
.5 Time delay on cooldown adjustable to 20 mins. [set at 4 min.]
.6 Test switch to simulate failure of normal power.
.7 Pilot light to indicate transfer switch is in normal position.
.8 Pilot light to indicate transfer switch is in emergency position.
.9 Auxiliary contact on main shaft (closed on normal).
.10 Auxiliary contact on main shaft (closed on emergency).
[.11 Overlapping neutral].
[.12 In phase monitor.]

.5 Standard of Acceptance ASCO 940.

2.6 Manual Bypass Isolation Switch

SPEC NOTE: Use 2.6 as required.

.1 Manual two-way bypass isolation switch to bypass the automatic transfer switch without interrupting power to the load, and to provide the means of periodic function testing, maintenance, and inspection of automatic transfer switch, along with associated emergency generation and control equipment.

.2 The bypass switch to be a three position manual transfer switch allowing the load to be transferred from one source to the other, if necessary, with the transfer switch totally removed from the system.

.3 The bypass switch to be furnished with a three position handle. Closed, Test and Open, and to function as a manual transfer switch to allow load transfer to either source of power.

.4 Standard of Acceptance ASCO 962.

2.7 Battery Charger

.1 [Free standing] [wall mounted] solid state input regulated and temperature compensated two-rate charger with:

.1 Output voltmeter 2% accuracy.

.2 Output ammeter 2% accuracy.

.3 Adjustable current limit control.

.4 Adjustable voltage limit control for float and equalize.

.5 Adjustable automatic equalize control set at [ ] hrs. following discharge or normal power failure.

.6 Indicators for:

.1 AC power on.

.2 Float mode.

.3 Equalize mode.

.7 Output voltage regulation ±0.5% with input voltage variations of ±10% under all load conditions.

.8 Input [120/240] [ ] volts [1Ø].

.9 Continuous full load output rating [12 VDC - 20 A] [24 VDC - 10 A].

2.8 Finishes

.1 Shop finish all metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, at least two coats of finish enamel.

.2 Clean and touch up surfaces of shop painted equipment scratched or marred during assembly or testing, to match original paint.

.3 Paint to be in accordance with CGSB 1-GP-88 M. Colour to be in accordance with CGSB 1-GP-12C 501-109 Grey.

.4 Control panel: Inside finish white, exterior finish grey.

.5 Supply 0.5 L of grey touch-up enamel.

2.9 Identification Plate

.1 Equipment identification plates and CSA labels to be affixed prior to delivery and shall be clearly visible and legible after equipment is installed.

.2 Identification Plate marking information to include:
Manufacturer's name -
Manufacturer's job number -
System or assembly serial number -
Engine serial number -
Delivery date (month, year) -
kW - Volt - Amp -
PH - Wire - HZ -
RPM -

.3 Identification plate shall be fabricated from anodized aluminum or commercial brass. The required marking shall be applied to the plate by metal stamp. System identification plates shall be attached to the front of the control panel door and be affixed by screws or rivets.

.4 Identification plate data shall be bilingual (English and French).

.5 Provide a bilingual warning sign where metric tools are required to service the engine-generator unit.

.6 Information to identify starter motor and battery voltage should read as follows:
Starting System Battery Voltage [12][24] volts. D.C.

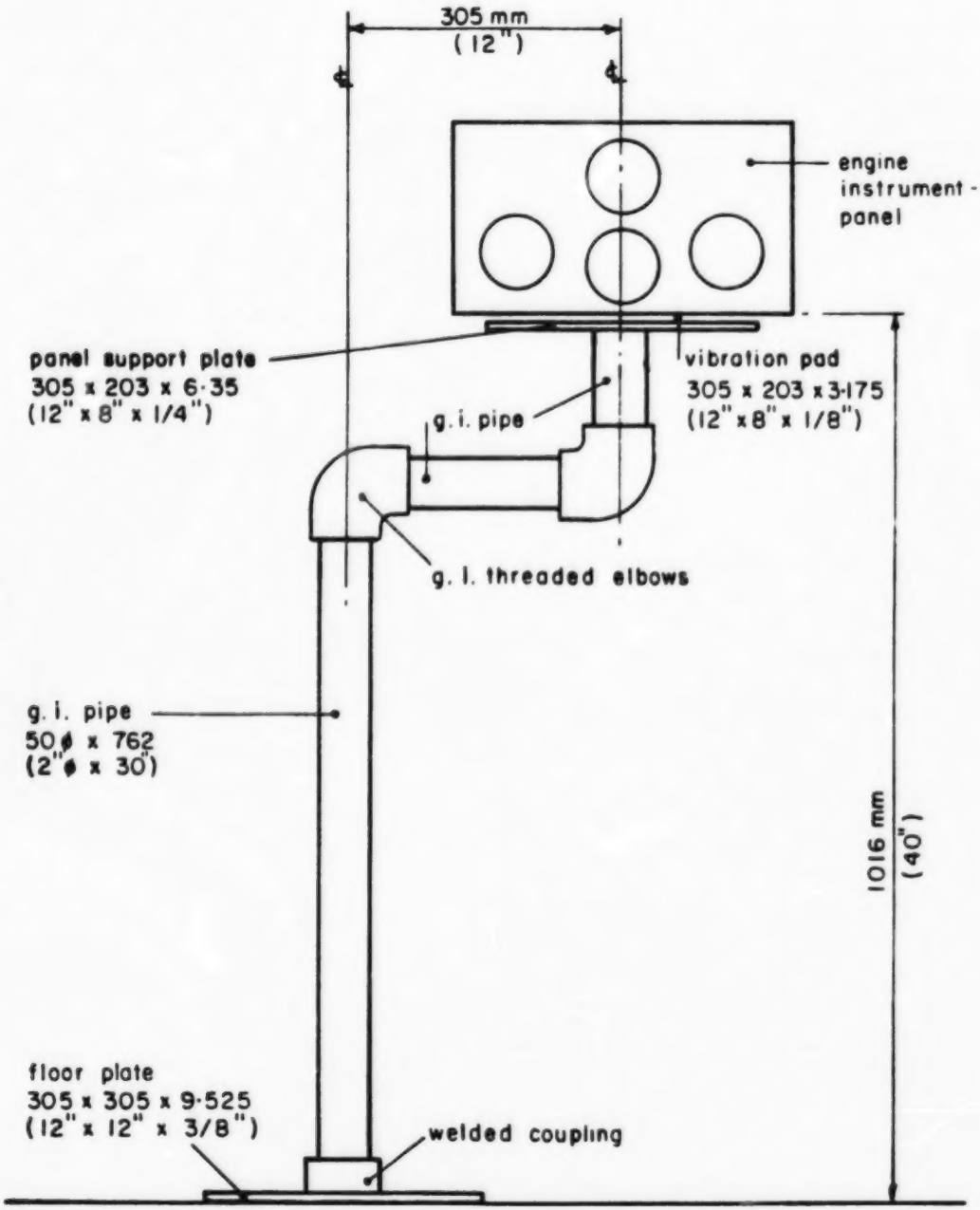
Standard Detail No. 1

THIS UNIT OPERATES
AUTOMATICALLY AND
MAY START AT ANY MOMENT

DANGER

CET APPAREIL AUTOMATIQUE
PEUT DEMARRER SUBITEMENT

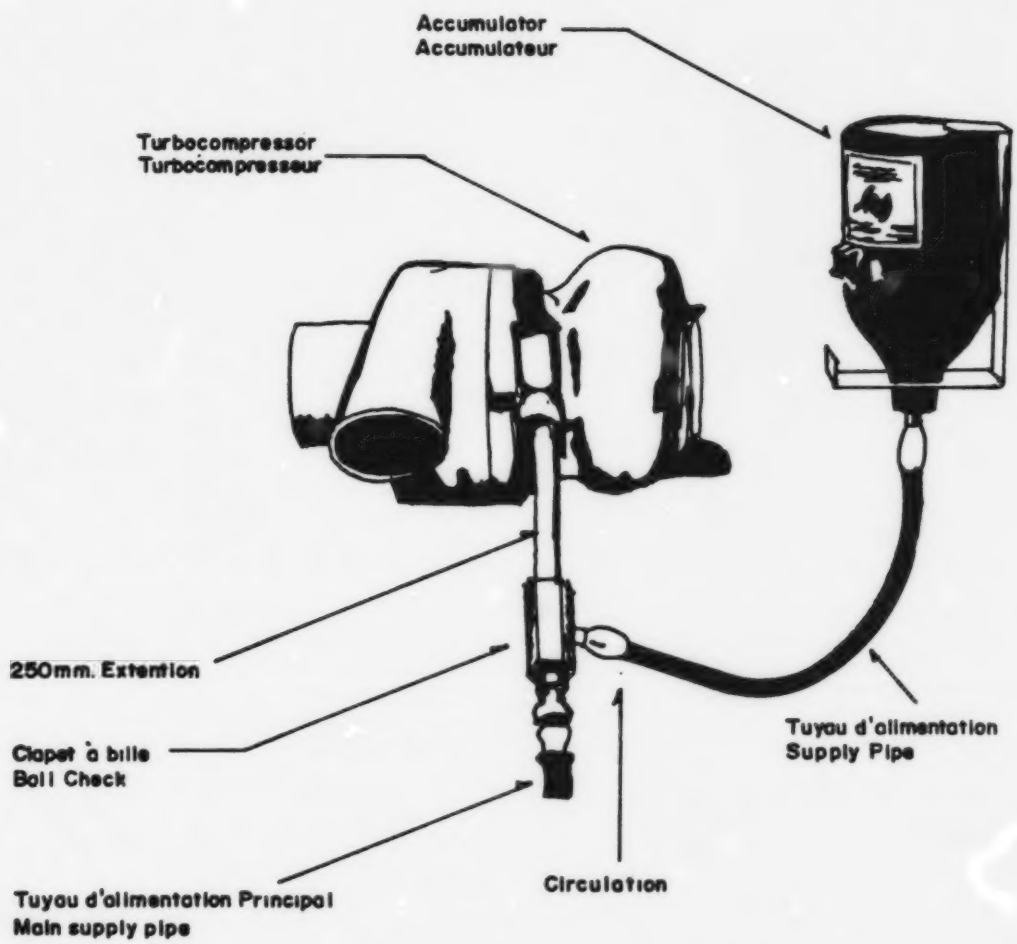
Standard Detail No. 2



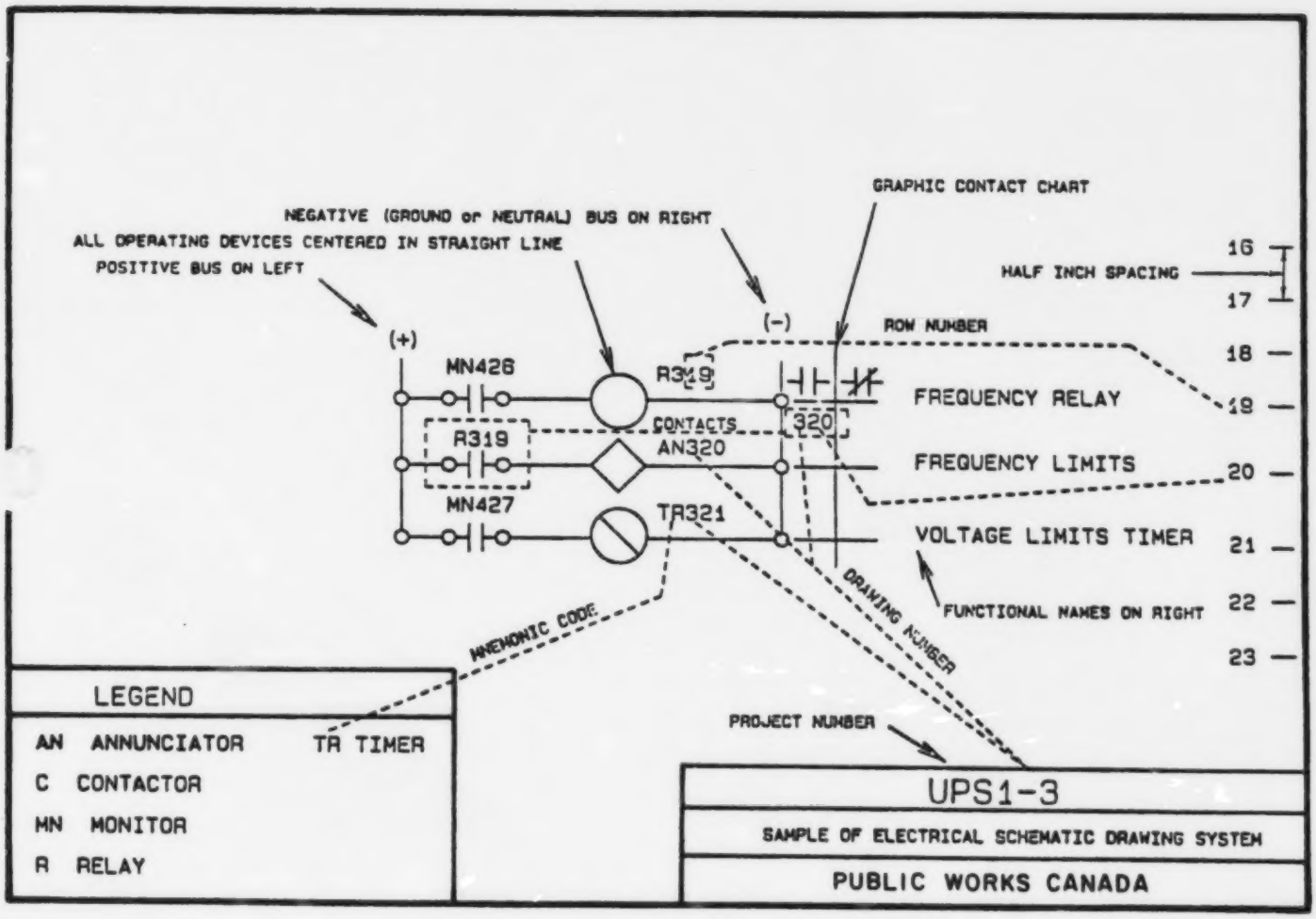
ENGINE INSTRUMENT-PANEL SUPPORT

Standard Detail No. 3

TURBOCHARGER ("COAST DOWN") LUBRICATION



Standard Detail No. 4



Standard Detail No. 5

LEGEND	AN 347 — ROW 47, DWG. 3	CONTACT CHART — N.O. 217 — DWG. 3, ROW 17	N.C. 329 — ROW 29, DWG. 3

AN	Annunciator
AS	Automatic Synchronizer
BC	Battery Charger
BCA	Battery Charging Alternator
BCG	Battery Charging Generator
BR	Bridge Rectifier
C	Contactor
CAP	Capacitor
CB	Circuit Breaker
CNL	Control Device
CT	Current Transformer
D	Diode Rectifier
DET	Detector (Fire, etc.)
E	Lightning Arrester
EC	Engine Controller
ET	Engine Temperature Switch
EX	Exhaust System Components
FS	Fuel Solenoid
FU	Fuse
G	Gauge
HR	Heater
L	Lights Indicator
LS	Audible Signal Device
M	Meter
MN	Monitor
MR	Motor
MT	Meter Transducer
O/L	Overload Element
PA	Parallelling Assembly
PC	Photo Cell
PL	Pilot Light
POT	Potentiometer
PS	Oil Pressure Switch
R	Relay
RES	Resistor
RH	Rheostat
RP	Receptacle
S	Switch
SOL	Solenoid
SS	Speed Switch
SV	Solenoid Valve
T	Transformer
TC	Thermocouple
TH	Thermostat
TR	Timing Relay
TS	Transfer Switch
UA	Unit Accessory (Diesel-Gen. Set)
VR	Voltage Regulator
VS	Ventilation System Component

VISUAL INSPECTION CHECKLIST

Date: _____

PROJECT: _____

		COMMENTS
1.0 ENGINE		
.1) Hose Clamps Tight	____	
.2) Pipe Fittings Tight	____	
.3) External Bolts Tight	____	
.4) Fan Belt Adjusted	____	
.5) Hose Bends and Routing	____	
.6) Battery Polarity	____	
.7) Coolant Level	____	
.8) Lube Oil Level	____	
.9) Fuel Lines Tight	____	
.10) Grease Water Pump	____	
.11) Conduit Connections Tight	____	
.12) Fuel Lines Clear of Conduit	____	
.13) Isolation and Pads Installed	____	
2.0 GENERATOR		
.1) All Connections Tight	____	
.2) Labelling	____	
3.0 INSTRUMENT PANEL		
.1) All Connections Tight	____	
.2) Wiring Loomed and Neat	____	
.3) Panel Mounts Secure	____	
.4) Labelling	____	
4.0 CONTROL CUBICLE		
.1) All Connections Tight	____	
.2) DC Polarity ____ Voltage	____	
.3) Wiring Loomed and Neat	____	
.4) Labelling	____	
5.0 SYSTEM		
.1) Load Bank Data	____	
.2) Complete System Interconnected	____	

COMMENTS

TEST VERIFICATION RECORD

Date: _____

PROJECT:

CONTRACTOR:

SUBCONTRACTOR:

PERSONNEL IN ATTENDANCE:

	NAME	INITIALS	TITLE
1) Subcontractor:			
2) Contractor:			
3) PWC:			

FACTORY ACCEPTANCE TESTS

EQUIPMENT UNDER TEST:

COMPONENTS	MANUFACTURER	MODEL #	SERIAL #
Diesel Engine			
Generator			
Control Cubicle			
Logic Controller			
Instrument Panel			

TEST VERIFICATION RECORD

Date: _____

1.0 NON-OPERATIONAL TESTS AND CHECKS

1.1 Visual Inspections

Comments:

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

1.2 Shaft Alignment Readings

Top - _____
Left - _____
Right - _____
Bottom - _____

Top - Bottom = _____
Top - Left = _____
Top - Right = _____
Left - Right = _____
Bottom - Left = _____
Bottom - Right = _____

max = __

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

1.3 End Float Reading _____ mm.

Comments:

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

1.4 Winding Resistance

Comments:

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

1.5 Electrical Wiring test

Comments:

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

TEST VERIFICATION RECORD (Cont'd)

Date: _____

1.6 Grease Lubrication Points

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

1.7 Safety Guard Checklist

Fan Guards: Radiator ____
Generator ____

Shields: Exhaust Manifold ____
Turbo ____
Exhaust Flex ____

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

Comments:

1.8 Air Cleaner - Visual Inspection

Comments:

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

1.9 Cooling System Tests

Pressure reading
after 2 minutes _____

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

1.10 Lube Oil Tests

Dipstick Reading: Pass __ Fail __

Oil Type _____

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

TEST VERIFICATION RECORD (Cont'd)

Date: _____

1.11 Fuel Oil Tests

Leaks: Pass __ Fail __

Comments:

Fuel Type: _____

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

1.12 Temperature and Pressure Sensors

Sensor		
(1) High Coolant Temp.		
- Pre-alarm	__	__
- Shutdown	__	__
(2) Lub. Oil Press. Low		
- Pre-Alarm	__	__
- Shutdown	__	__

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

1.13 Tools and Spares

Comments:

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

TEST VERIFICATION RECORD (cont'd)

Date: _____

2.0 PROTECTION (ALARM) AND CONTROL DEMONSTRATION

2.1 Overheat Protective Device Test

Electrical Shutdown Check:
High Coolant Temp ___ sec.
Unit Fail ___
Reset ___

(See section 1.13 for Sensor Calibration)

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

2.2 Low Oil Pressure Protection

Electrical Shutdown Check:
Low Oil Press. ___ sec.
Unit Fail ___
Low Oil Press. ___
Reset ___

(See section 1.13 for Sensor Calibration)

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

2.3 Cranking Cycle

3 Crank Cycles:

Starts cranking ___ sec.
Ends cranking ___ sec. Dur.: __ sec.

Starts ___ sec. Dur.: __ sec.
Ends cranking ___ sec. Dur.: __ sec.

Starts ___ sec. Dur.: __ sec.
Ends cranking ___ sec. Dur.: __ sec.

Overcrank indication yes _____ no _____
Unit fail indication yes _____ no _____

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

Comments:

TEST VERIFICATION RECORD (cont'd)

Date: _____

2.4 Overspeed Protection

- See Cranking Test 2.3

2.5 Overspeed Protection

			Initial	
			Accepted	Rejected
Shutdown speed:	= _____ Hz.			
Overspeed indication:	yes __ no __			
Voltage at Shutdown Limit	_____ v	SUBCON:	_____	_____
		or CON:	_____	_____
		PWC:	_____	_____

2.6 Electrical Fault Protection

2.7 Transfer Switch

.1 Transfer to Genset on Normal Power Failure: yes __ no __
Time Delay _____ secs.

.2 Retransfer to Normal Power yes __ no __
Time Delay _____ mins.

2.8 Voltage out of Limits

			Initial	
			Accepted	Rejected
.1 Overvoltage Trip @ ___ volts				
Unit fail indication:	yes _ no _			
Voltage limit annun.:	yes _ no _			
		SUBCON:	_____	_____
.2 Undervoltage trip @ ___ volts		or CON:	_____	_____
Unit fail indication:	yes _ no _	PWC:	_____	_____
Voltage limit annun.:	yes _ no _			

TEST VERIFICATION RECORD (cont'd)

Date: _____

2.9 Frequency Out of Limits

		Initial	
		Accepted	Rejected
.1 Overfrequency Trip @ ___ Hz			
Unit fail indication: yes __ no __			
.2 Underfrequency Trip @ __ Hz	SUBCON:	_____	_____
Unit fail indication: yes __ no __	or CON:	_____	_____
Frequency limit annun.: yes __ no __	PWC:	_____	_____

2.10 Control Functions

			Initial	
			Accepted	Rejected
2.10.1	No. cranks to start = _____			
2.10.2	Genset Stops _____			
2.10.3	No. cranks to start = _____			
2.10.4	Transfer switch transfers _____	SUBCON:	_____	_____
	Load: normal ___ emergency ___	or CON:	_____	_____
2.10.5	Load: normal ___ emergency ___	PWC:	_____	_____
2.10.6	Genset Stops ___			
2.10.7	No. cranks to start = _____			
2.10.8	No. cranks to start = _____			
2.10.9	IL1 = _____ amps			
	IL2 = _____ amps			
	IL3 = _____ amps			
2.10.10	No. cranks to start = _____			
2.10.11	Load transferred to normal? _____			

3.0 LOAD/AMBIENT 9 or 25-HOUR TESTS

		Initial	
		Accepted	Rejected
See Test Data Sheets			
6.0			
7.0			
	SUBCON:	_____	_____
	or CON:	_____	_____
	PWC:	_____	_____

TEST VERIFICATION RECORD (cont'd)

Date: _____

4.0 LOAD RESPONSE TESTS

4.1 Starting time (Obtain Chart Recording)

Load Set-up: _____
Objective = _____ kW
Battery Voltage = _____ VDC

IL1 = _____ A VE12 = _____ V
IL2 = _____ A VE23 = _____ V
IL3 = _____ A VE31 = _____ V
AV = _____ A AV = _____ V = _____ kW

1) Voltage: Time to achieve rated voltage +/-1% = ____ seconds

2) Frequency: Time to achieve 60 Hz +/-1 Hz = _____ seconds
Criteria = [15] seconds, Maximum = ____ seconds

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

4.2 Load Pick-up/Rejection tests

Load Set-up

Test Run # ___ Objective: ___% Load = ___ kW

IL1 = _____ A VE12 = _____ V
IL2 = _____ A VE23 = _____ V
IL3 = _____ A VE31 = _____ V
Average ___ A Average ____ V = _____ kW

Test Run # ___ Objective: ___% Load = ___ kW

IL1 = _____ A VE12 = _____ V
IL2 = _____ A VE23 = _____ V
IL3 = _____ A VE31 = _____ V
Average ___ A Average ____ V = _____ kW

TEST VERIFICATION RECORD (cont'd)

Date: _____

4.2 Load Pick-up/Rejection tests (cont'd)

Load Set-up

Test Run # ___ Objective: ___% Load = ___ kW

IL1 = _____ A VE12 = _____ V
IL2 = _____ A VE23 = _____ V
IL3 = _____ A VE31 = _____ V
Average ___ A Average _____ V = _____ kW

Test Run # ___ Objective: ___% Load = ___ kW

IL1 = _____ A VE12 = _____ V
IL2 = _____ A VE23 = _____ V
IL3 = _____ A VE31 = _____ V
Average ___ A Average _____ V = _____ kW

Test Run # ___ Objective: ___% Load = ___ kW

IL1 = _____ A VE12 = _____ V
IL2 = _____ A VE23 = _____ V
IL3 = _____ A VE31 = _____ V
Average ___ A Average _____ V = _____ kW

FROM TO LOAD kW	RUN	kW	VOLTAGE FLUCTUATION	FREQUENCY DEVIATION	RECOVERY TIME
Criteria			[± 18%] max.*	[± 3%] max.*	[3 sec.] max.*
0-100					
100-0					
0-75					
75-0					
0-50					
50-0					
0-25					
25-0					

* Figures in brackets to agree with governor and voltage regulator requirements sections 2.1.6 and 2.2.10.

	Initial Accepted	Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____
PWC:	_____	_____

TEST VERIFICATION RECORD (cont'd)

Date: _____

5.0 VIBRATION TESTS

5.1 Vibration Levels

(1) (2) (3)
R
A Engine/Gen
D
(6) (5) (4)

	Horz.	Vert.	Axial.		Initial Accepted	Initial Rejected
(1)	___	___	___ mm/s			
(2)	___	___	___ mm/s			
(3)	___	___	___ mm/s	SUBCON:	_____	_____
(4)	___	___	___ mm/s	or CON:	_____	_____
(5)	___	___	___ mm/s	PWC:	_____	_____
(6)	___	___	___ mm/s			

5.2 Vibrarion Isolation Efficiency

SKID mm/s	FLOOR mm/s	EFF. %
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

	Initial Accepted	Initial Rejected
SUBCON:	_____	_____
or CON:	_____	_____
PWC:	_____	_____

6.0 WINDING RESISTANCE AND INSULATION TEST DATA SHEET

DATE: _____
TEST BY: _____
SUBCON: _____
or CON: _____
PWC: _____

ENGINE: MAKE: _____ GENERATOR: MAKE: _____
MODEL: _____ MODEL: _____
SERIAL #: _____ SERIAL #: _____

COLD TEST AMBIENT TEMP. = _____ Degrees C.

HOT TEST AMBIENT TEMP. = _____ Degrees C. (TAH)
(Temp. Probe at Generator Air Intake)

CRITERIA: Maximum Temperature Rise = [105] Degrees C.

6.0 WINDING RESISTANCE AND INSULATION TEST DATA SHEET (cont'd)

	RESISTANCE				
	COLD TEST (RC)	HOT TEST (RH)	RATIO RH/RC	DEG.C HOT TEMP. (TH)	TEMP. RISE DEG. C (TH-TAH)
A) Resistance Test - Generator Stator (Milliohms)					
A1) PhA-L1					
A2) PhB-L2					
A3) PhC-L3					
B) Resistance Test - Generator Rotor Field (Ohms)					
B1)					
C) Resistance Test - Exciter Field (Ohms)					
C1)					
D) Insulation Test - (Megaohms)					
D1) Stator					
D2) Exciter					
D3) Rotor					

7.0 TEST DATA SHEET FOR LOAD/AMBIEXT TEMPERATURE TEST

TIME											CRITERIA	APP
Hourmeter												
AMBIEXT TEMP.												
T1												
T2												
T3												
ENGINE												
Oil Temp.												
Water Temp.												
Oil Pressure												
EXH Temp.												
Max. Pressure												
GENERATOR												
Temp - In												
Temp - Out												
Temp.- Frame												
EXCITER												
Volts												
Amps												
1-PHASE VOLTS												
L1 - N												
L2 - N												
L3 - N												
Frequency												
3-PHASE VOLTS												
VE 31												
VE 23												
VE 12												
Average												
CURRENT												
IL 3												
IL 2												
IL 1												
Average												
LOAD												
kW												
%												
Test by												

Initial
Accepted Rejected

SUBCON: or _____ _____
CON: _____ _____
PWC: _____ _____

Tender Requirements .1 Include the following:

.1 Detailed description and specification of diesel engine, generator and auxiliary equipment.

.2 Engine manufacturer's certified, published engine continuous and standby output curves and calculations of unit power output, after derating for site conditions and ALL power absorbing accessories. Photocopies of engine output curves are not acceptable.

.3 Guaranteed fuel consumption at full load.

.4 Sample of technical literature and specifications.

.5 List of tools normally supplied with unit.

.6 List of spare parts normally supplied with unit.

.7 Detailed description of in plant test facilities available to test unit.

.8 Description of service facilities in Canada.

.9 Description of special features.

.10 Dates of delivery for all equipment specified.

.11 Multi-grade, heavy duty, 15W40, engine crankcase oil (MIL-L-2104D) will be used. Documentation from the engine manufacturer to accompany tender, to acknowledge that the use of this oil, in the diesel engine to be supplied, is authorized for use, for all load conditions and will not void engine manufacturer's warranty when used under normal and design conditions.

.12 Generator efficiency for all conditions specified.

.13 Time duration and cost for one instructor (technician) to instruct PWC personnel on the care, operation, and description of the system.

.14 Manufacturer's descriptive literature for components to be supplied to include, but not limited to: engine, generator, governor, voltage regulator, transfer isolating and by-pass switch, battery charger, etc.

.15 PWC reserves the right to reject any bid in the event that the above information or any part thereof is not furnished with the bidders tender.

.16 Evaluation of Canadian content as defined in CGSB STD. CAN2-147.3-82

Tender Requirements (cont'd)

.1 (cont'd)

.17 Evidence that the manufacturer has been engaged for at least five (5) years in the manufacturing and installation of Diesel Generator Sets.

.18 Provide evidence that a Canadian distributor has been established and will stock in Canada spare parts for the complete generator set during the normal life of the set.

.19 The following technical data shall be forwarded by the bidder as part of his tender and it shall be clearly understood that no tenders will be considered complete unless the required data is provided with the tender documents. The Department reserves the right to reject such incomplete tenders.

.2 Engine:

.1 Manufacturer's name _____

.2 Model number _____

.3 Certified Continuous _____ kW
and standby ratings _____ kW

.4 Weight of engine, generator and heat exchanger _____ kg

.5 Total weight of complete assembly including control panel _____ kg

.6 Fuel Oil and Lubricating Oil consumption at 100% generator rated output in accordance with ISO 3046/1-1986 _____

.3 Generator:

.1 Manufacturer's name _____

.2 Model number _____

.3 Kilowatt rating _____ kW

.4 kVA rating _____ kVA

Tender Requirements (cont'd)

.3 Generator: (cont'd)

.5 Temperature rise of stator NEMA class F _____ °C

.6 Certified generator efficiency (to be certified by generator manufacturer) _____ % @ FL

.4 Miscellaneous:

.1 Name of battery manufacturer _____

.2 Model number of battery _____

.3 Ampere-hour capacity of battery _____

.4 Voltage regulator:
MAKE _____
MODEL _____
TYPE _____

.5 Governor:
MAKE _____
MODEL _____

.6 Generator CB:
MAKE _____
MODEL _____

.7 Silencer:
MAKE _____
MODEL _____

.8 Isolators:
MAKE _____
MODEL _____